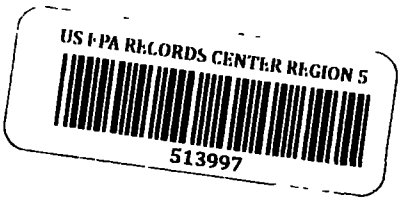
9/22/81
C.4



ANALYSIS OF ENVIRONMENTAL SAMPLES IN SUPPORT OF EPA REGION V

WORK PLAN

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
Division of Stationary Source Enforcement

Date Prepared: 22 September 1981

Under Contract No.: 68-01-6316

Technical Service Area 1

Work Assignment No. 24, Tasks B,C,D,E

(GCA 1-452-124B-E)

GCA CORPORATION
GCA/TECHNOLOGY DIVISION
Bedford, Massachusetts 01730

2.0 TABLE OF CONTENTS

3.0 INTRODUCTION

ANALYSIS OF ENVIRONMENTAL SAMPLES FOR EPA REGION V

Contractor: GCA/Technology Division Location: Bedford, Massachusetts

Contract Project Manager: Kenneth T. McGregor

Contract Business Representative: Arthur Engelman

EPA Project Officer: John R. Busik

EPA Task Manager: Mike Kosakowski

headwaters site

The primary objective of this task is to provide analytical support services to EPA Region V. These efforts will consist of quantification of several organic and inorganic components in environmental samples from the Reilly Tar and Chemical Superfund site, St. Louis Park, Minnesota.

The work required will involve qualitative and quantitative analysis of water, sludge, soil and oil-phase water for extractable and volatile organics, PAH, and sodium. Qualitative spot-test analysis for PAH in soil will also be provided. Descriptions of the major work elements, including analytical procedures and quality assurance/quality control protocols designed for this program will be detailed in the following sections.

and other conventional parameters.

4.0 PROJECT DESCRIPTION

4.1 Technical Objective

The objective of this task is to provide analytical support services to EPA Region V, Surveillance and Analysis Division. These services will include the analysis of the following: 6 quality control water, 77 water and 11 sludge samples for PAH; 150 soil samples for PAH (several to be spot-tested prior to quantitative analysis); and 80 water samples (some of which will be oil-phase water for PAH), volatile and extractable organics and sodium.

4.2 Analysis of PAH by HPLC

Samples will be analyzed for PAH using reversed-phase HPLC with ultraviolet and fluorescence spectrophotometers operated in series. The reversed phase column, a Perkin-Elmer HC-ODS will be operated isocratically using 65 percent acetonitrile in water as the mobile phase. Sample preparation procedures are unique for each sample matrix as outlined below.

4.2.1 Water Samples - Water samples (1-liter) will be prepared for HPLC analysis according to the extraction procedures described in the December 3, 1979 Federal Register (Method 610: 40 CFR Part 136). An aliquot of the concentrated methylene chloride extract will be solvent-exchanged into acetonitrile and screened for PAH using the HPLC techniques described above. The silica gel cleanup, detailed in Method 610, will be implemented as required, on samples exhibiting significant interferences. Detection limits for this analysis will be from 1 to 10 ppb. ppt

The above procedures will be implemented for the 6 quality control samples in Task 1, the 77 waters from Task 2, and any of the Task 4 samples (80 waters) not containing an organic phase.

4.2.2 Soil (Peat) Samples - Soil samples will be prepared for PAH analysis using the method titled, "Analysis of Sediment for General Organics by Mechanical Dispersion Extraction" as contained in "Interim Methods for the Sampling and Analysis of Priority Pollutants in Sediments and Fish Tissue" (U.S. EPA, EMSL, Cincinnati, Ohio). This procedure utilizes ultrasonic homogenization of the sample with acetonitrile as the extraction solvent. The acetonitrile extract is then diluted with a 2 percent sodium sulfate solution at pH 11. The PAH components are then partitioned into methylene chloride and concentrated to 10.0 ml. The extract will be subjected to the silica gel cleanup described in Section 4.2.1 and screened for PAH. Matrix interferences will be removed, as necessary via gel permeation chromatography using Biobeads SX-3 and ethyl acetate elution solvent (EPA-600/8-80-038). Detection limits for this analysis will be 0.1 ppm. These procedures will be utilized for the 150 soil samples from Task 3.

4.2.3 Oil-Phase Water Samples - The separated phases from two phase samples will be prepared for PAH analysis individually and the extracts combined in a ratio proportional to that of the original sample. Water phases will be pH adjusted and extracted with methylene chloride (Method 610). This extract will be held for combination with the appropriate extract of surface oil. Oil phase samples will be extracted and partitioned into methylene chloride as described in Section 4.2.2. The final extracts will be combined and the solvent reduced for the silica gel/gel permeation cleanup procedures discussed in Section 4.2.2. These methods will be utilized for the analysis of Task 4 water samples with an organic phase.

4.3 Analysis of PAH in Sludge by GC/MS

Sludge samples will be prepared for analysis using the methods described in Section 4.2.3 for soil samples. GC/MS analysis will be performed using a Hewlett-Packard 5985 operated in the selected-ion mode with a 30-meter SE-54 wall-coated open tubular column. Detection limits for this analysis are anticipated to be 10 ppm. These techniques will be used for the 11 sludge samples of Task 2.

4.4 Analysis of Volatile Organics in Water by GC/MS

Analysis for volatile organics in aqueous samples will be accomplished using the December 3, 1979 Federal Register procedures (Method 624), modified to accommodate a five-fold sample volume increase. Identification of nonlisted components will be achieved by computerized probability based matching with the NBS/EPA/NIH Library of Mass Spectral Data. Spectral matches will be manually confirmed. Detection limits will be between 0.5 and 1.0 ppb. This analysis will be performed on the 80 water samples in Task 4.

4.5 Analysis of Extractable Organics in Water by GC/MS

Aqueous samples will be prepared for the analysis of base-neutral and acid extractable organics according to Method 625 as outlined in 40 CFR Part 136. A 30-meter SE-54 fused-silica capillary column will be used in place of the specified packed column in order to provide optimum resolution of the components of interest. Identification of nonlisted components will be achieved as outlined in Section 4.4. Detection limits typically range from 5 to 25 ppb for this analysis. The 80 water samples in Task 4 will be analyzed using this method.

4.6 Analysis of Water for Sodium

Sodium analysis of the 80 water samples in Task 4 will be performed according to procedures detailed in "Standard Methods for the Examination of Water and Wastewater," 14th Edition.

4.7 Polynuclear Aromatic Hydrocarbon-Spot Test Fluorescence Screening Procedures

A PAH screening protocol will be applied to solvent extracts of each of the 150 soil samples addressed previously in Section 4.2.2. A modified spot test employing a sensitized fluorescence technique will be used prior to subsequent HPLC analysis (EPA-600/7-78-182). This technique will employ sample extract

application to a paper or multichanneled thin-layer chromatographic media. Multiple sample extracts will be applied to a single plate, followed by elution with a binary solvent system such as cyclohexane/benzene (4:1). The PNA isolated bands are located via a hand-held UV lamp preset at 254 nm. Implementation of this procedure should isolate samples warranting further investigation via the HPLC fluorescence procedures noted earlier in Section 4.2. It is anticipated that limits for total PAH detection material will be in the low ppb (µg/kg) range using one of the above screening protocols.

4.8 Quality Assurance

4.8.1 Introduction - The objective of the quality assurance program is to ensure that complete, precise, accurate and representative data are provided. The key individual responsible for quality assurance is the Division QA Manager who reports directly to the Division General Manager. Specific quality control measures for this program will be the responsibility of the Laboratory Quality Control Coordinator.

4.8.2 Quality Control - Quality Control (QC) for this program will involve the use of blind spikes and duplicates and laboratory control samples. Blind spikes and duplicates will be inserted at the time samples are received at the Sample Bank. Laboratory control samples will be analyzed prior to the start of sample analysis to verify instrument operation and sample preparation; a blank and a laboratory control sample will be analyzed with each group of 20 samples processed.

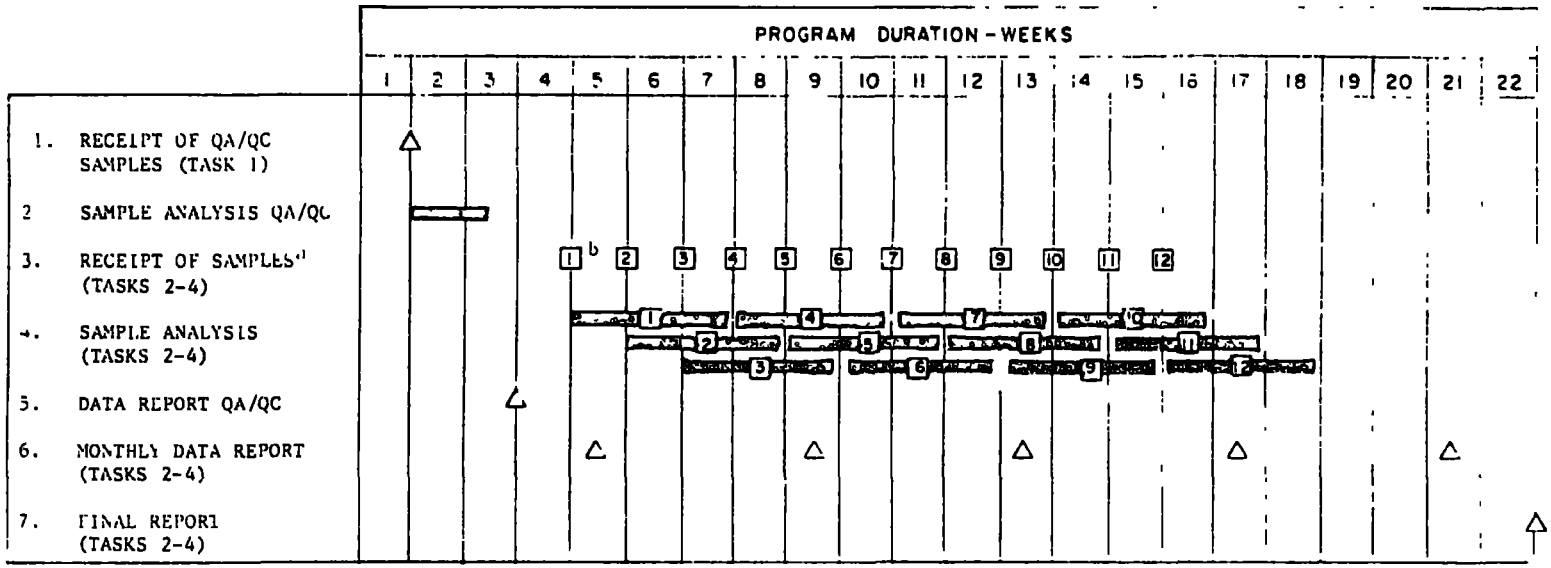
Duplicates and spikes will constitute approximately 10 to 15 percent of the sample total. Quality control samples will be prepared from EPA or NBS concentrates.

4.8.3 Precision and Accuracy - The precision and accuracy limits for each method have been established through routine QC analyses in this laboratory and achieve published precision and accuracy requirements for the methods used. Precision will be determined by the analysis of replicate

samples and reported as percent relative standard deviation. Accuracy will be reported as percent recovery of a spike or percent relative error.

4.8.4 Quality Control Reports - The Laboratory Quality Control Coordinator is required to prepare monthly quality control reports for the Laboratory Manager and Division QA Manager. These reports detail the number of samples submitted and the precision and accuracy achieved, as well as any corrective action indicated during the reporting period. The Final Report will contain all QA/QC data generated during the project.

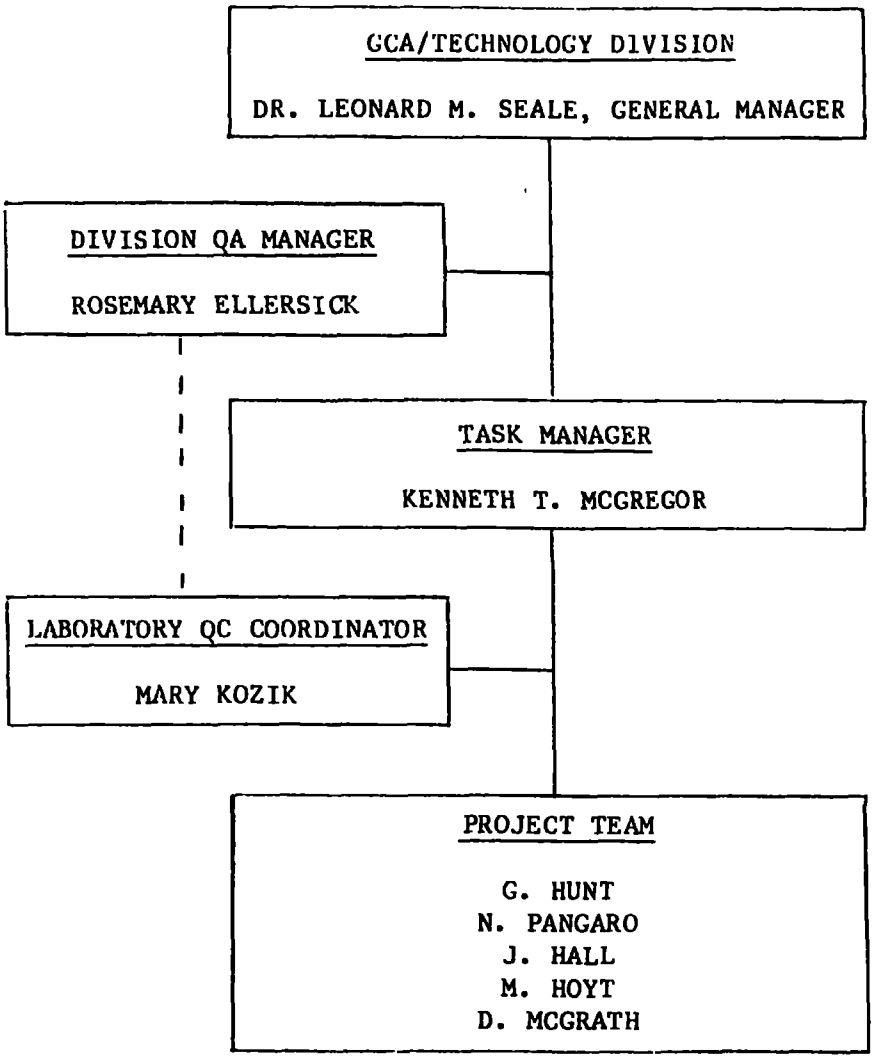
5.0 PROJECT SCHEDULE



[a]Assumes receipt of a maximum of 20 samples for each type of analysis (e.g., HPLC, GC/MS) per calendar week of program.

[b]Numbers refer to batch numbers of samples as stated above

6.0 PROJECT ORGANIZATION CHART



7.0 COST ESTIMATE

GCA/TECHNOLOGY DIVISION
A DIVISION OF GCA CORPORATION
Bedford, Massachusetts 01730

25 September 1981

COST ESTIMATE

TASK B

ENGINEERING INVESTIGATIONS - SIX (6) QUALITY CONTROL WATER SAMPLES

Contract No. 68-01-6316, Technical Service Area 1, Assignment 24, Task B
(GCA 1-452-124B)

Direct Labor

Grade	Description	Hourly Rate[2]	No. of Hours	Total
10	Group Scientist/Engineer	$18.74/hr	4	$ 75
8	Staff Scientist/Engineer	$12.98/hr	10	130
7	Senior Scientist/Engineer	$11.07/hr	16	177
6	Scientist/Engineer	$ 9.26/hr	10	93
5	Junior Scientist/Engineer	$ 7.31/hr	20	146
4	Senior Technician	$ 6.78/hr	10	68
4	Technical Illustrator	$ 6.74/hr	4	27
3	Technical Typist	$ 5.76/hr	12	69
Total Direct Labor			86 hours[3]	$ 785
Salary Related Cost[1] (32.5%)				255
Subtotal				1,040
Engineering Overhead[1] (90.0%)				936
Purchased Material (see Page 2)				147
Subtotal				2,123
G&A Expense[1] (3.7%)				79
Total Estimated Cost				2,202
Fixed Fee				191
TOTAL TASK COST				$2,393

Notes: (1) Indirect rates have been submitted to both EPA and DCAA for GCA/FY 1981.

(2) Use of GCA/CY 1981 direct labor billing rates.

(3) Of this total, 70 are technical man-hours; as such, 3,430 technical man-hours remain uncommitted under this assignment.

TASK B

PURCHASED MATERIAL
(GCA 1-452-124B)

1.	Methylene chloride, DIG, J.T. Baker, Woburn, MA - 2 gallons @ $14/ea	$ 28
2.	Acetone, DIG, J.T. Baker - 1 gallon @ $8.25/ea	8
3.	Acetonitrile, 4 l, J.T.Baker - 1 gallon @ $44.42/ea	44
4.	Hamilton Syringe, 50 µl, Curtin Matheson Scientific, Woburn, MA - 2 each @ $17.82/ea	36
5.	HPLC recorder paper, Laboratory Instrumentation Services, Dorchester, ma - 1 roll @ $5.50/ea	5
6.	Pipet, 10 ml, Curtin Matheson - 1 each @ $2.61/ea.	3
7.	Pipet, 1 ml, Curtin Matheson - 1 each @ $3.00/ea	3
8.	Pasteur pipettes, Curtin Matheson - 1 each @ $6.64/ea.	7
9.	Volumetric flask, 10 ml, 2 each @ $6.36/ea	13
	TOTAL TASK B PURCHASED MATERIAL	$147

HPLC

7.0 COST ESTIMATE

GCA/TECHNOLOGY DIVISION
A DIVISION OF GCA CORPORATION
Bedford, Massachusetts 01730

25 September 1981

COST ESTIMATE

TASK C

ENGINEERING INVESTIGATIONS - 77 water samples; 11 SLUDGE

Contract No. 68-01-6316, Technical Service Area 1, Assignment 24, Task C
(GCA 1-452-124C)

Direct Labor

Grade	Description	Hourly Rate[2]	No. of Hours	Total
10	Group Scientist/Engineer	$18.74/hr	36	$ 675
8	Staff Scientist/Engineer	$12.98/hr	88	1,142
7	Senior Scientist/Engineer	$11.07/hr	160	1,771
6	Scientist/Engineer	$ 9.26/hr	88	815
5	Junior Scientist/Engineer	$ 7.31/hr	180	1,316
4	Senior Technician	$ 6.78/hr	118	800
4	Technical Illustrator	$ 6.74/hr	26	175
3	Technical Typist	$ 5,76/hr	54	311
Total Direct Labor			750 hours[3]	$7,005
Salary Related Cost[1] (32.5%)				2,277
Subtotal				9,282
Engineering Overhead[1] (90.0%)				8,354
Purchased Material (see Page 2)				1,222
Subtotal				18,858
G&A Expense[1] (3.7%)				698
Total Estimated Cost				19,556
Fixed Fee				1,828
TOTAL TASK COST				$21,384

Notes: (1) Indirect rates have been submitted to both EPA and DCAA for GCA/FY 1981.

(2) Use of GCA/CY 1981 direct labor billing rates.

(3) Of this total, 670 are technical man-hours; as such, 2,760 technical man-hours remain uncommitted under this assignment.

TASK C

PURCHASED MATERIAL
(GCA 1-452-124C)

1.	Methylene chloride, DIG, J.T. Baker, Woburn, MA - 3 cases @ $56/case	$ 168
2.	Acetonitrile, DIG, 4 l, J.T. Baker - 3 bottles @ $44.42/ea	133
3.	Pentane, J.T.Baker - 3 bottles @ $15/ea	45
4.	Ethyl Acetate, 4 l, J.T.Baker - 3 bottles @ $19.31/ea.	58
5.	Biobeads, S-X3, BioRad, Richmond, California - 300 g @ $50/100 g	150
6.	Silic AR CC-4, Mallinckrodt, Scientific Products, Bedford, MA - 12 lbs @ $52.88/4 lb	159
7.	Asst'd PAH Standards, Chem Service, Inc, West Chester, PA -	100
8.	Separatory funnel, 2 l, Curtin Matheson Scientific, Woburn, MA - 3 each @ $62.78/ea	188
9.	Graduated cylinder, 1 l, Curtin Matheson Scientific - 3 each @ $19.48/ea	58
10.	Pipet - Volumetric, 10 ml, Curtin Matheson - 3 each @ $2.61/ea.	8
11.	Pipet - Volumetric, 1 ml, Curtin Matheson - 3 ea @ $3/ea	9
12.	Volumetric flask, 10 ml, Curtin Matheson - 3 each @ $6.36/ea	19
13.	Volumetric flask, 1 ml, Curtin Matheson - 3 each @ $7.63/ea.	23
14.	Volumetric flask, 2 ml, Curtin Matheson - 2 each @ $8.68/ea.	17
15.	Hamilton syringe, 50 µl, Curtin Matheson- 3 each @ $17.82/ea	53
16.	HPLC recorder paper, Laboratory Instrument Services, Dorchester, MA - 3 rolls @ $5.50/ea	17
17.	Chromatography columns, Ace Glassware, Vineland, NJ - 3 each @ $5.55/ea	17
	TOTAL TASK C PURCHASED MATERIAL	$1,222

assumption 50% to HPLC

7.0 COST ESTIMATE

GCA/TECHNOLOGY DIVISION
A DIVISION OF GCA CORPORATION
Bedford, Massachusetts 01730

25 September 1981

HPLC

COST ESTIMATE

TASK D

ENGINEERING INVESTIGATIONS - 150 SOIL SAMPLES

Contract No. 68-01-6316, Technical Service Area 1, Assignment 24, Task D
(GCA 1-452-124D)

Direct Labor

Grade	Description	Hourly Rate[2]	No. of Hours	Total
10	Group Scientist/Engineer	$18.74/hr	60	$ 1,124
8	Staff Scientist/Engineer	$12.98/hr	150	1,947
7	Senior Scientist/Engineer	$11.07/hr	390	4,317
6	Scientist/Engineer	$ 9.26/hr	150	1,389
5	Junior Scientist/Engineer	$ 7.31/hr	300	2,193
4	Senior Technician	$ 6.78/hr	450	3,051
4	Technical Illustrator	$ 6.74/hr	60	404
3	Technical Typist	$ 5.76/hr	120	691
Total Direct Labor			1,680 hours[3]	$15,116
Salary Related Cost[1] (32.5%)				4,913
Subtotal				20,029
Engineering Overhead[1] (90.0%)				18,026
Purchased Material (see Page 2)				2,437
Subtotal				40,492
G&A Expense[1] (3.7%)				1,498
Total Estimated Cost				41,990
Fixed Fee				4,092
TOTAL TASK COST				$46,082

Notes: (1) Indirect rates have been submitted to both EPA and DCAA for GCA/FY 1981.

(2) Use of GCA/CY 1981 direct labor billing rates.

(3) Of this total, 1,500 are technical man-hours; as such, 1,260 technical man-hours remain uncommitted under this assignment.

TASK D

PURCHASED MATERIAL
(GCA 1-452-124D)

1.	Methylene chloride, DIG 4 l, J.T.Baker, Woburn, MA - 6 cases @ $56/ea	$ 336
2,	Acetonitrile, DIG, 4 l, J.T.Baker - 6 bottles @ $44.42/ea.	267
3.	Ethyl acetate, 4 l, J.T. Baker - 6 bottles @ $19.31/ea	116
4.	Pentane, J.T. Baker, 6 bottles @ $15/ea	90
5.	Acetone, DIG, 4 gal-1 cs, J.T. Baker - 2 cases @ $33/ea.	66
6.	E-size soxhlets, Ace Glassware, Vineland, NJ - 6 each @ $53.05/ea	318
7.	Asst'd PAH standards, Chem Service, West Chester, PA	100
8.	Biobeads, S-X3, BioRad, Richmond, CA - 6 each @ $50/ea	300
9.	Silic AR CC-4, Scientific Products, Bedford, MA - 6 each @ $52.88/ea	317
10.	Syringe, 50 µl, Hamilton, Curtin Matheson Scientific, Woburn, MA - 4 each @ $17.82/ea	71
11.	HPLC recorder paper, Laboratory Instrument Supply, Dorchester, MA - 6 rolls @ $5.50/ea	33
12.	Chromatography column, Ace Glassware - 6 each @ $5.55/ea.	33
13.	Separatory funnel, 2 l, Curtin Matheson - 4 each @ $62.88/ea	252
14.	Graduated cylinder, 1 l, Curtin Matheson - 4 each @ $19.48/ea.	78
15.	Pasteur pipets, Curtin Matheson - 2 each @ $6.64/ea	13
16.	Volumetric flask, 1 ml, Curtin Matheson - 3 each @ $7.63/ea.	23
17.	Volumetric flask, 10 ml, Curtin Matheson - 2 each @ $6.36/ea	13
18.	Volumetric pipet, 1 ml, Curtin Matheson - 2 each @ $3/ea	6
19.	Volumetric pipet, 10 ml, Curtin Matheson - 2 each @ $2.61/ea	5
	TOTAL TASK D PURCHASED MATERIAL	$2,437

7.0 COST ESTIMATE

GCA/TECHNOLOGY DIVISION
A DIVISION OF GCA CORPORATION
Bedford, Massachusetts 01730

GCMS

25 September 1981

COST ESTIMATE

TASK E

ENGINEERING INVESTIGATIONS - 80 WATER SAMPLES

Contract No. 68-01-6316, Technical Service Area 1, Assignment 24, Task 4
(GCA 1-452-124E)

Direct Labor

Grade	Description	Hourly Rate[2]	No. of Hours	Total
10	Group Scientist/Engineer	$18.74/hr	60	$ 1,124
8	Staff Scientist/Engineer	$12.98/hr	140	1,817
7	Senior Scientist/Engineer	$11.07/hr	220	2,435
6	Scientist/Engineer	$ 9.26/hr	625	5,787
5	Junior Scientist/Engineer	$ 7.31/hr	575	4,203
4	Senior Technician	$ 6.78/hr	540	3,661
4	Technical Illustrator	$ 6.74/hr	86	580
3	Technical Typist	$ 5.76/hr	172	991
Total Direct Labor			2,418 hours[3]	$20,598
Salary Related Cost[1] (32.5%)				6,694
Subtotal				27,292
Engineering Overhead[1] (90.0%)				24,563
Purchased Material (see Page 2)				3,409
Subtotal				55,264
G&A Expense[1] (3.7%)				2,045
Total Estimated Cost				57,309
Fixed Fee				5,892
TOTAL TASK COST				$63,201

Notes: (1) Indirect rates have been submitted to both EPA and DCAA for GCA/FY 1981.

(2) Use of GCA/CY 1981 direct labor billing rates.

(3) Of this total, 2,160 are technical man-hours; as such, 900 technical man-hours are overcommitted under this assignment.

TASK E

PURCHASED MATERIAL
(GCA 1-452-124E)

1.	Methylene chloride, DIG, J.T.Baker, Woburn, MA - 9 cases @ $56/ea	$ 504
2.	Acetonitrile, DIG, 4 l, J.T. Baker - 9 bottles @ $44.42/ea	400
3.	Pentane, J.T. Baker - 9 bottles @ $15/ea	135
4.	Ethyl acetate, 4 l, J.T. Baker - 10 bottles @ $19.31/ea.	193
5.	Biobeads, S-X3, BioRad, Richmond, CA - 900 g @ $50/100 g	450
6.	Silic AR CC-4, Mallinckrodt, Scientific Products, Bedford, MA - 32 lbs @ $52.88/4 lbs	423
7.	Asstd. PAH standards, Chem Service, West Chester, PA	150
8.	Separatory funnels, 2 l, Curtin Matheson Scientific, Woburn, MA - 8 each @ $62.78/ea	502
9.	Graduated cylinder, 1 l, Curtin Matheson - 8 each @ $19.48/ea	156
10.	Volumetric pipet, 1 ml, Curtin Matheson - 9 each @ $3/ea.	27
11.	Volumetric pipet, 10 ml, Curtin Matheson - 9 each @ $2.61/ea.	23
12.	Volumetric flask, 1 ml, Curtin Matheson - 9 each @ $7.63/ea	69
13.	Volumetric flask, 10 ml, Curtin Matheson - 8 each @ $6.36/ea.	51
14.	Volumetric flask, 2 ml, Curtin Matheson - 9 each @ $8.68/ea	78
15.	Hamilton syringe, 50 µl, Curtin Matheson - 6 each @ $17.82/ea	107
16.	HPLC recorder paper, Laboratory Instrument Services, Dorchester, MA - 8 rolls @ $5.50/ea	44
17.	Chromatography columns, Ace Glassware, Vineland, NJ - 8 each @ $5.55/ea	44
18.	Pasteur pipets, Curtin Matheson - 8 each @ $6.64/ea	53
	TOTAL TASK E PURCHASED MATERIAL	$3,409

7.0 COST ESTIMATE

GCA/TECHNOLOGY DIVISION
A DIVISION OF GCA CORPORATION
Bedford, Massachusetts 01730

25 September 1981

SPREAD SUMMARY SHEET BY TASK
(GCA 1-452-124)

Item Direct Labor Grade	Description	Hourly Rate	Task A[1] (hrs/$)	Task B[2] (hrs/$)	Task C[2] (hrs/$)	Task D[2] (hrs/$)	Task E[2] (hrs/$)	Summary - All Tasks (hrs/$)
10	Group Scientist/Engineer	$18.74/hr	40/$ 750	4/$ 75	36/$ 675	60/$ 1,124	60/$ 1,124	200/$ 3,748
9	Principal Scientist/Engineer	$15.20/hr	20/ 304	-	-	-	-	20/ 304
8	Staff Scientist/Engineer	$12.98/hr	60/ 779	10/ 130	88/ 1,142	150/ 1,947	140/ 1,817	448/ 5,815
7	Senior Scientist/Engineer	$11.07/hr	130/ 1,439	16/ 177	160/ 1,771	390/ 4,317	220/ 2,435	916/ 10,139
6	Scientist/Engineer	$ 9.26/hr	290/ 2,685	10/ 93	88/ 815	150/ 1,389	625/ 5,787	1,163/ 10,769
5	Junior Scientist/Engineer	$ 7.31/hr	480/ 3,509	20/ 146	180/ 1,316	300/ 2,193	575/ 4,203	1,555/ 11,367
4	Senior Technician	$ 6.78/hr	480/ 3,254	10/ 68	118/ 800	450/ 3,051	540/ 3,661	1,598/ 10,834
Total Technical Man-hours			1,500	70	670	1,500	2,160	5,900[3]
4	Technical Illustrator	$ 6.74/hr	60/ 404	4/ 27	26/ 175	60/ 404	86/ 580	236/ 1,590
3	Technical Typist	$ 5.76/hr	120/ 691	12/ 69	54/ 311	120/ 691	172/ 991	478/ 2,753
Total Direct Labor (hrs/$)			1,680/$13,815	86/$785	750/$7,005	1,680/$15,116	2,418/$20,598	6,614/$57,319
Salary Related Cost (32.5%)			4,490	255	2,277	4,913	6,694	18,629
Subtotal			18,305	1,040	9,282	20,029	27,292	75,948
Engineering Overhead (90.0%)			16,475	936	8,354	18,026	24,563	68,354
Other Direct Costs			4,266	-	-	-	-	4,266
Material			2,273	147	1,222	2,437	3,409	9,488
Subtotal			41,319	2,123	18,858	40,492	55,264	158,056
G&A Expense (3.7%)			1,529	79	698	1,498	2,045	5,849
Total Estimated Cost			42,848	2,202	19,556	41,990	57,309	163,905
Fixed Fee			4,092	191	1,828	4,092	5,892	16,095
TOTAL ESTIMATED COST & FEE			$46,940	$2,393	$21,384	$46,082	$63,201	$180,000

Notes: (1) Included in Work Plan submitted 8/10/81
(2) See Task cost estimate enclosed herein
(3) This figure is 900 technical man-hours in excess of that designated under Assignment 24.

CONTRACT NO. 68-01-6316
TSA 1, TASK 24
(GCA 1-452-124) *REVISED 9/25/81*
TASKS A-E

X——X ESTIMATED EXPENDITURES
X- - - -X ACTUAL EXPENDITURES
⊙——⊙ ESTIMATED MAN-HOURS
⊙- - - -⊙ ACTUAL MAN-HOURS